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LISTS OF SPECIES

Anurans in bromeliads, Parque Estadual da Serra do Brigadeiro, state of Minas Gerais, southeastern Brazil

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Abstract: This study presents a list of anurans associated to bromeliads in *Parque Estadual da Serra do Brigadeiro*, state of Minas Gerais, southeastern Brazil. It also brings information regarding the type of association between these anurans and plants. We recorded eight species belonging to five genera and two families, Cycloramphidae and Hylidae. The most abundant species was *Scinax* gr. *perpusillus*, followed by *Scinax* aff. *perereca*, *Dendropsophus minutus*, *Bokermannohyla circumdata*, *Hypsiboas faber*, *Thoropa miliaris*, *Hypsiboas polytaenius* and *Dendropsophus elegans*. Most species observed occupying bromeliads uses these microhabitats only as diurnal shelter. *Scinax* gr. *perpusillus* was the only classified as bromeligenous, depending upon the plants to complete its reproductive cycle.

Introduction

Most species of amphibians have nocturnal habits and reproduce in the warmer and wet season of the year, avoiding exposure to diurnal higher temperatures and lower atmospheric humidity (Duellman and Trueb 1994; Pombal Jr. 1997). Anurans, in the course of their evolution, colonized much diversified types of microhabitats (Pertel et al. 2006). During the day, they are commonly found in places with high moisture and not exposed to sunlight, such as under rocks, inside trunks, shady cracks and inhabiting bromeliads leaves (Duellman and Trueb 1994).

The bromeliads, due to its tank shaped forms, are capable of storing rainwater, providing both nutrient reserves and refuge to many species of vertebrates and invertebrates (Ambruster et al. 2002; Rocha et al. 2004). Among the vertebrates, anurans are the most commonly found in association with bromeliads (Rocha et al. 2004). These plants are considered a relatively safe habitat for anurans tadpoles and spawns, compared to puddles and streams, where competitors and predators are more abundant (Lehtinen et al. 2004).

Peixoto (1995) categorized almost 50 species of anurans in Atlantic rainforest according to its type of association to bromeliads: the bromelicolous species would be those that use the plant as a shelter but its reproductive cycle is not dependent on the plant while the bromeligenous are strictly dependent on the plant, where they spend the entire life cycle.

This study presents a list of anurans associated to bromeliads in the central region of *Parque Estadual da Serra do Brigadeiro*, in municipalities of Araponga and Fervedouro, state of Minas Gerais, southeastern Brazil. It also brings information regarding the type of association between these amphibians and plants.

Material and methods

Field work was carried out at the central region of *Parque Estadual da Serra do Brigadeiro* – PESB (20°43' S, 42°29' W) (Figure 1), municipalities of Araponga and Fervedouro, state of Minas Gerais, southeastern Brazil. PESB is a conservation unit that covers approximately 15,000 ha of the Atlantic rainforest biome, managed by *Instituto Estadual de Florestas* – IEF, in the northern part of the Mantiqueira mountain range complex, state of Minas Gerais (Cruz et al. 2007; Caramaschi et al. 2008) reaching altitudes above 1,800 meters (Feio et al. 2008).

We visited the central region of the park monthly from August 2007 to July 2008 (visits lasting three nights each). We sampled bromeliads in five different sites: (1) the banks of a temporary pond

(20°42'55"S, 42°29'10"W) with nine bromeliads; (2) the banks of a permanent stream (20°43'54"S, 42°27'49"W) with ten bromeliads; (3) near the park's administrative building (20°43'19"S, 42°28'43"W), with about 40 bromeliads used for ornamental function; (4) a rocky outcrop with 3 clusters containing hundreds of bromeliads (20°44'12"S, 42°29'37"W); (5) a second rocky outcrop with dozens of clusters containing thousands of bromeliads (20°43'13"S, 42°28'48"W). We visited this second rocky outcrop only in October and November 2007, and on January and April 2008.

In this study only ground bromeliads were sampled, particularly *Alcantarea extensa* (Figure 2), a giant tank bromeliad (Pertel et al. 2006) capable of storing a large amount of water, as others bromeliads from the same genus, offering the necessary moisture to guarantee survival of anuran specimens (Teixeira and Rödder 2007). We carried out visual surveys, on arbitrary schedules. As Silva and Alves-Silva (2008), we collected the tadpoles from bromeliads using a collecting aspirator, similar to an insect aspirator that is inserted in the bromeliad and used to drain the water from the leaf-tanks of the plants. Tadpoles were released back to the bromeliad after identification with the original water. Since the plants did not need to be removed, these techniques did not cause any harm to the bromeliads.

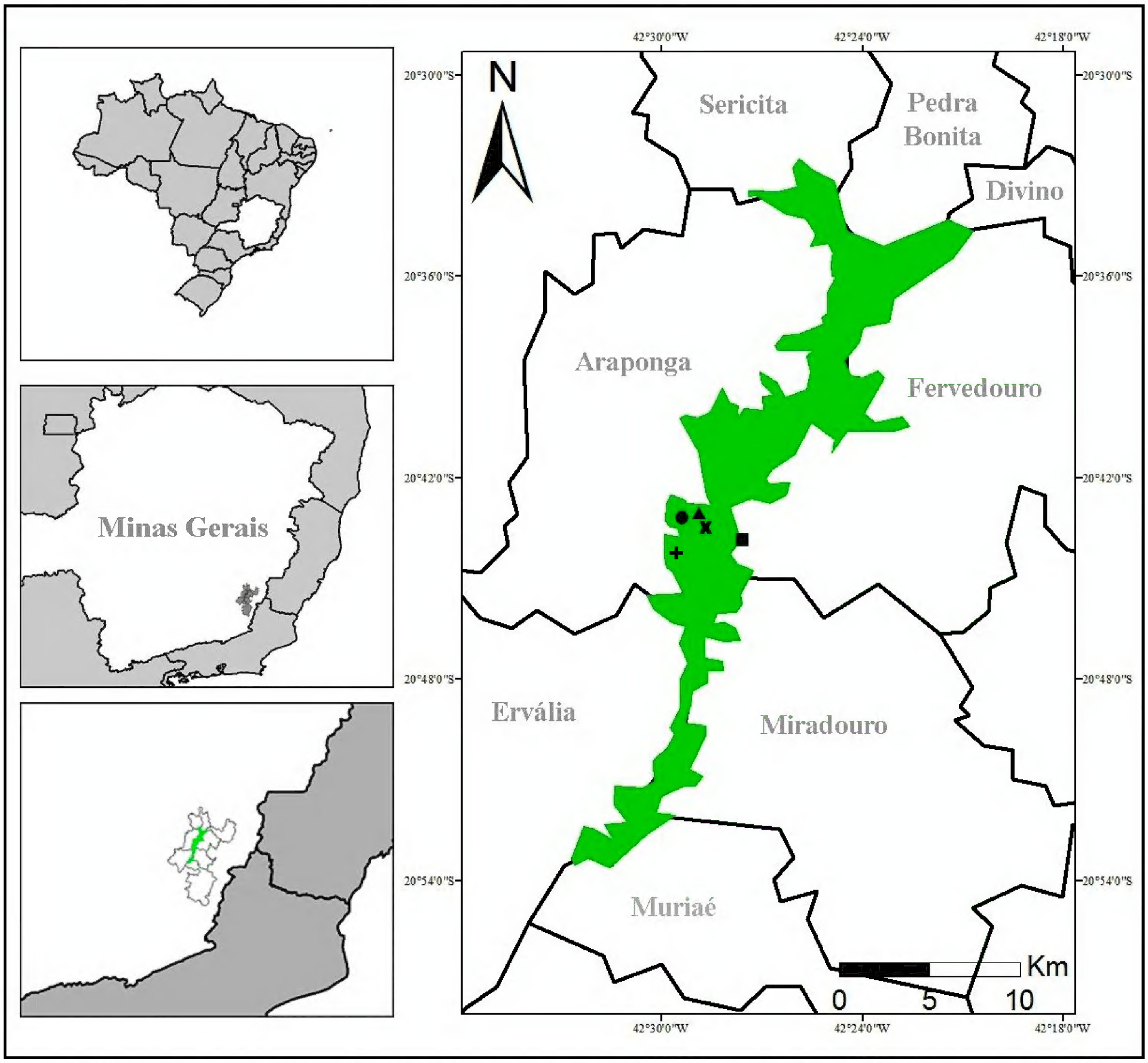

Figure 1. Localization of *Parque Estadual da Serra do Brigadeiro*, state of in Minas Gerais, southeastern Brazil: the temporary pond ( ); permanent stream (Ā); park´s administrative building (**x**); rocky outcrop with 3 clusters of bromeliads (+); and rocky outcrop with dozens of clusters of bromeliads (Ȁ).

Results and discussion

We recorded a total of 52 individuals belonging to eight species in five genera and two families, Cycloramphidae and Hylidae, inside bromeliads (Table 1). The most abundant species was *Scinax* gr. *perpusillus* (N = 21; 40.3%), followed by *Scinax* aff. *perereca* (N = 18; 34.6 %), *Dendropsophus minutus* (Peters, 1872) (N = 5; 9.6 %), *Bokermannohyla circumdata* (Cope, 1871) (N = 2; 3.8 %), *Hypsiboas faber* (Wied-Neuwied, 1821) (N = 2; 3.8 %), *Thoropa miliaris* (Spix, 1824) (N = 2; 3.8 %), *Hypsiboas polytaenius* (Cope, 1869) (N = 1; 1.9 %) and *Dendropsophus elegans* (Wied-Neuwied, 1824) (N = 1; 1.9 %) (Figure 3).

The highest number of species (n = 6) was found inside ornamental bromeliads near the park's administrative building. Only *Dendropsophus minutus* and *Thoropa miliaris* were not found inside these plants. Each environment has characteristics species, so the diversity of species is directly related to the environment heterogeneity (Haddad et al. 2008). Thus, the proximity of ornamental bromeliads to forest, ponds, streams and rocky outcrops may explain this greater diversity of species in these plants compared to the other study sites. Despite the high number of bromeliads inspected at the rocky outcrops, only three species were found at these localities: *Scinax* gr. *perpusillus*, *Scinax* aff. *perereca* and *Thoropa miliaris*. Two species, *Dendropsophus minutus* and *Scinax* aff. *perereca*, were found inside bromeliads on the banks of the temporary pond. The lowest diversity of anurans species was recorded inside bromeliads on the banks of the stream, where only one individual of *B. circumdata* was found.

The most frequently recorded species inside the tanks of bromeliads, here referred as *Scinax* gr. *perpusillus*, is apparently a species not yet described (Feio et al. 2008). It belongs to the *Scinax perpusillus* species group, characterized by small species whose larvae develop obligatory in the water accumulated by bromeliads (Peixoto 1987). All but one individuals of this species were found inside bromeliads located at the rocky outcrops. From October 2007 to January 2008, we observed reproductive activity and occurrence of tadpoles from *Scinax* gr. *perpusillus* (Figure 4) in abundance inside bromeliads. Only one individual was recorded in the ornamental plants.

Feio et al. (2008) suggest that the second most abundant species recorded by us inside bromeliads, here referred as *Scinax* aff. *perereca*, is probably not yet described. They also noticed that these species is very common in the park and can be easily found in bromeliads.

Figure 2. Specimen of *Alcantarea extensa* from *Parque Estadual da Serra do Brigadeiro*.

Five individuals of *Dendropsophus minutus* were found associated to bromeliads. It is one of the most common species of anurans, with wide distribution in South America (Frost 2008), considered versatile and tolerant (Cei 1980), with generalists reproductive habits being found in activity during the night near streams, puddles and swamps (Eterovick and Sazima 2004). This species was recorded inside bromeliads only from the bank of the temporary pond in August and September (when the pond was dry). As Eterovick and Sazima (2004), we observed a large number of *D. minutus* in reproductive activity during the rainy season, from October to February, on the vegetation around the pond when it was flooded. During this period, we did not record any individual of this species inside bromeliads, what probably means that its reproductive activity does not occur in association with these plants. In September we also observed one individual of *Thamnodynastes* cf. *nattereri* (Serpentes; Dipsadidae) (Figure 5) among the bromeliads from the banks of this temporary pond. Once this species commonly uses amphibians as prey (Pontes and Rocha 2008), we believe that it could probably be foraging anurans inside those plants.

We observed two individuals of *Bokermannohyla circumdata* inside bromeliads: one at the stream's banks and other inside an ornamental bromeliad, relatively close to a stream. No specimen was found near the pond or at the rocky outcrop, probably because this species is typical of lotic waters (Napoli and Caramaschi 2004) using the bromeliads only as shelter.

Two individuals of *Hypsiboas faber* were recorded, both using ornamental bromeliads. We believe that this species, due to its reproductive habit, also uses these plants only as a shelter, not for reproduction, as observed in most species recorded during this study. The male of *H. faber* usually builds small circular pools at the banks of ponds or dams, where they vocalize to attract the female (Izecksohn and Carvalho-e-Silva 2002).

Both individuals of *Thoropa miliaris* were observed inside bromeliads on the rocky outcrops, from where it is characteristic, and their adults and tadpoles can be found (Feio et al. 2006). In PESB, only adults were found inside bromeliads.

Only one specimen of *Hypsiboas polytaenius* and one of *Dendropsophus elegans* were found in bromeliads. Feio et al. (2008) mentioned that both species are commonly found in areas modified by human presence, which is supported by the fact that both individuals were observed in plants relatively close (about 3 meters) to PESB´s administrative building.

Peixoto (1995) listed a great amount of anurans associated, somehow, to bromeliads in Atlantic rainforest of southeastern Brazil. None of the species found during the present study were included on his list. *Thoropa miliaris* was already found occupying bromeliads in the state of Espírito Santo by Teixeira et al. (2006) and Teixeira and Rödder (2007). They suggested that these species only uses the plant as a diurnal shelter. Teixeira and Rödder (2007) also found *Hypsiboas faber* inside a bromeliad tank from a saxicolous habitat of southeastern Brazil and suggested that this species is only sometimes bromelicolous.

According to the classification proposed by Peixoto (1995), based on the type of association between the anuran and the bromeliad, we suggest that all species recorded in this study are categorized as bromelicolous (species that can be found in bromeliads with reproductive cycle not associated by any aspect to these plants) except for *Scinax* gr. *perpusillus*, characterized as bromeligenous, due to its entire life cycle associated to bromeliads.

Table 1. Species of anurans registered in bromeliads in *Parque Estadual da Serra do Brigadeiro*, state of Minas Gerais, southeastern Brazil, in five different sites: **TP**) bank of temporary pond; **PS**) bank of permanent stream; **Or**) ornamental bromeliads near the administrative building; **RO_1**) rocky outcrop with three clusters of bromeliads; and **RO_2**) rocky outcrop with dozens of clusters of bromeliads.

Taxon	Sites				
	TP	**PS**	**Or**	**RO_1**	**RO_2**
Family Cycloramphidae					
Thoropa miliaris (Spix, 1824)	-	-	-	1	1
Family Hylidae					
Bokermannohyla circumdata (Cope, 1871)	-	1	1	-	-
Dendropsophus elegans (Wied-Neuwied, 1824)	-	-	1	-	-
Dendropsophus minutus (Peters, 1872)	5	-	-	-	-
Hypsiboas faber (Wied-Neuwied, 1821)	-	-	2	-	-
Hypsiboas polytaenius (Cope, 1870)	-	-	1	-	-
Scinax aff. *perereca*	2	-	10	6	-
Scinax gr. *perpusillus*	-	-	1	2	18

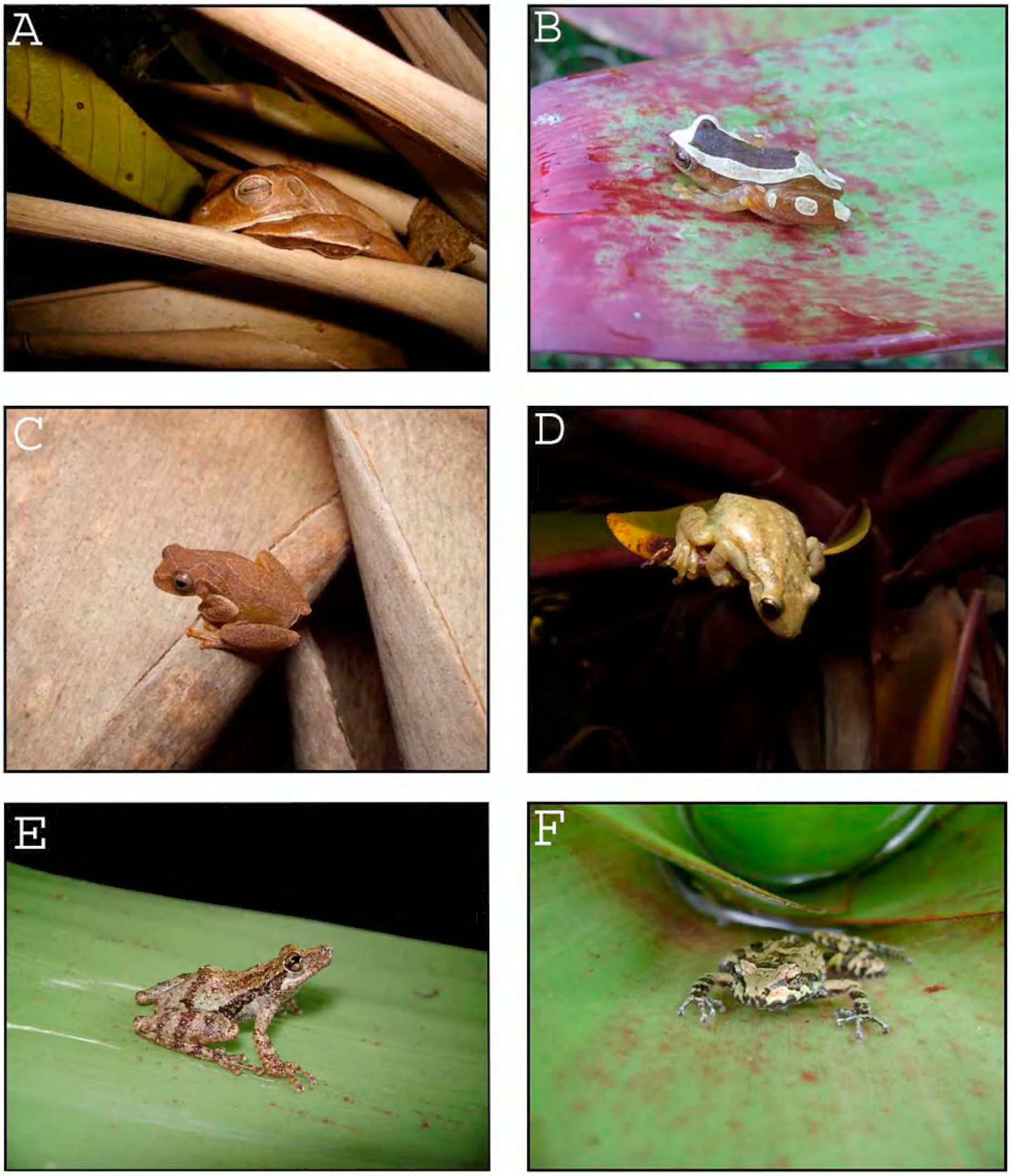

Figure 3. Anuran species from *Parque Estadual da Serra do Brigadeiro* found inside bromeliads: A) *Bokermannohyla* circumdata, B) *Dendropsophus elegans*, C) *Dendropsophus minutus*, D) *Scinax* aff. *perereca*, E) *Scinax* gr. *perpusillus*, F) *Thoropa miliaris*.

Apparently, the number of species recorded by us should not be considered very high, especially when compared to Peixoto (1995), who evidenced almost 50 species associated, somehow, to bromeliads in Atlantic rainforest. However, when compared to other studies from a restrict location in this biome, the number of species found by us should be considered relatively high. Schneider and Teixeira (2001), studying the relationship between anurans and bromeliads of the sandy coastal plain of Regência, Linhares, Espírito Santo, southeastern Brazil, recorded six species occupying these plants. Teixeira et al. (2002) recorded five species of anurans in bromeliads from a *restinga* habitat at *Praia das Neves*, municipality of Presidente

Kennedy, southeastern Brazil. Pertel et al. (2006) studying anurans inhabiting soil bromeliads in a fragment of the Atlantic rainforest of Santa Teresa, southeastern Brazil also recorded five species. Teixeira et al. (2006) studying the ecology of anurans inhabiting bromeliads in a saxicolous habitat of southeastern Brazil found two species. Teixeira and Rödder (2007) observed six species in a rapid assessment of an anuran community inhabiting tank bromeliads in rocky habitat in the state of Espírito Santo, southeastern Brazil.

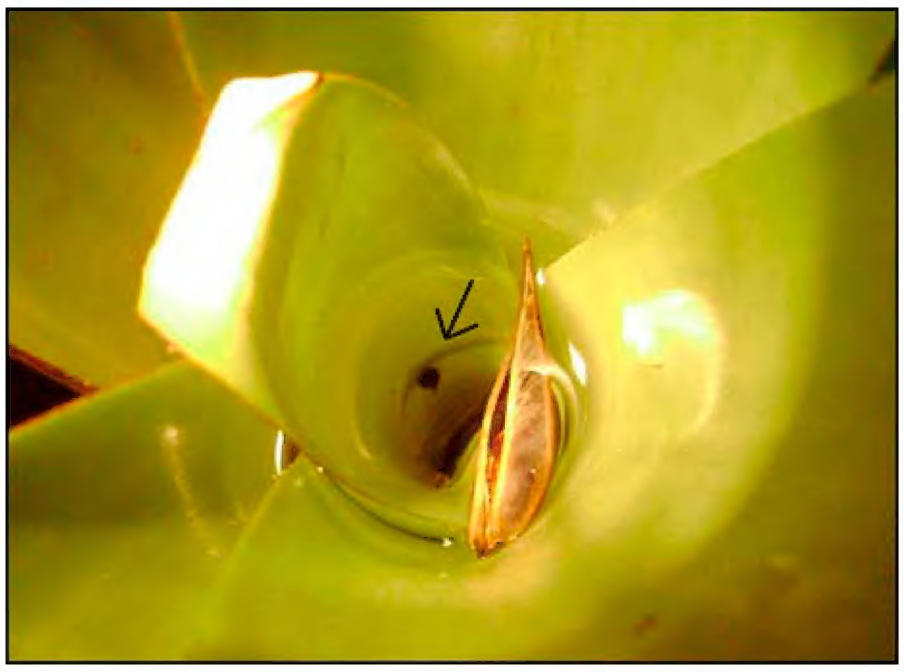

Figure 4. Tadpole of *Scinax* gr. *perpusillus* (pointed by the arrow) inside a bromeliad tank.

Figure 5. Individual of *Thamnodynastes* cf. *nattereri* found among bromeliads.

Many anuran habits peculiarities are still to be elucidated and further studies are necessary to better understand the complexity of the relationship between anurans and bromeliads (Schneider and Teixeira 2001). The conservation of bromeliads is very important to the maintenance of some population of anurans, especially for those with the reproductive cycle directly dependent on these plants, as observed in *Scinax* gr. *perpusillus* from *Parque Estadual da Serra do Brigadeiro*.

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